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ABSTRACT

This master's thesis presents several instructional methods and techniques developed for each of eleven topics or subject areas in clinical chemistry: carbohydrate metabolism, lipid metabolism, diagnostic enzymology, endocrinology, toxicology, quality control, electrolytes, acid base balance, hepatic function, nonprotein nitrogenous compounds, and proteins. Behavioral objectives for instructor and students are written for each of these subject areas. Instructional methods and techniques used for presenting each of the areas include lectures, textbooks, programmed study, handout sheets, student reports or papers, discussions, and still projection media. (CS)

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TEACHING TECHNIQUES IN CLINICAL CHEMISTRY

By

Diane Wilson, B.A. MT(ASCP)

A Thesis
Submitted to the Faculty of
Mississippi State University
in Partial Fulfillment of the Requirements
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TEACHING TECHNIQUES IN CLINICAL CHEMISTRY

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ABSTRACT

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ABSTRACT

Clinical chemistry, one of the disciplines of medical technology, involves eleven diverse subject areas. Carbohydrate metabolism, lipid metabolism, diagnostic enzymology, endocrinology, toxicology, quality control, electrolytes, acid base balance, hepatic function, nonprotein nitrogenous compounds (NPN), and proteins are the different subject areas that are covered in clinical chemistry.

Considering the various learning characteristics of the students, seven instructional methods and techniques are discussed for the teaching of the lecture portion of clinical chemistry. Lecture, textbooks, programmed study, handout sheets, student reports or papers, discussions, and still projection media are the methods and techniques employed for presentation of the eleven subject areas in clinical chemistry.

This thesis presents several instructional methods and techniques for each of the eleven topics or subject areas of clinical chemistry.

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Behavioral objectives for instructor and students are also given for each of the eleven subject areas.

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INTRODUCTION

Clinical chemistry is one of the disciplines in the "3+1" hospital based program of the medical technology curriculum. The time alloted for the course is twelve weeks with five one hour lectures and two hours for laboratory per week.

Quality control, carbohydrate and lipid metabolism, proteins and amino acids, electrolytes, acid base balance, endocrinology, diagnostic enzymology, hepatic function, nonprotein nitrogenous (NPN) compounds and toxicology are the subject areas taught in clinical chemistry.

Educators in the health sciences are faced with many significant developments that require the creation of flexible yet complete instructional programs designed to prepare students to assume future professional responsibilities (Henderhan and Schroeder, 1980). Since clinical chemistry (lecture portion) involves eleven diverse areas, it warrants the consideration of different instructional techniques and methods. Olsen (1978) stated that instructional decisions should be based not only upon student assessment data but also upon the general purpose and philosophy of the course, the topics and content and student characteristics bearing in mind that what works well in one situation may be inappropriate in another. Bloom (1978) also has stated that the solution to improvement in education can only be realized when the diversity of students and instructional methods is realized.

Each of the eleven subject areas of clinical chemistry contains instructor and student behavioral objectives in the cognitive domain. According to "What's Wrong with Behavioral Objectives", the highly specific nature of the behavioral objectives makes them particularly

useful tools for instructional design and measurements. Also it was implied that instructional methods in which educational goals are defined in behavioral terms are more effective in promoting student learning (Fisher, 1978).

Considering the diversity of the students and the subjects in clinical chemistry, seven instructional methods and techniques are presented for the instruction of the lecture portion of clinical chemistry. Lecture, textbooks, programmed study, handout sheets, student reports or papers, discussions and still projection media are the methods and techniques used for the presentation of the eleven subjects in clinical chemistry.

This thesis presents several instructional methods and techniques for each of the eleven topics or subjects of clinical chemistry. Behavioral objectives for students and instructor are also presented. This thesis also presents a discussion of the different instructional techniques or methods that can be used to present the topics or subjects. One way media include the following: lecture, textbooks, still projection media and handout sheets.

Two way media include only discussion. Programmed instruction and student reports or papers comprise the self instructional media.

LECTURE

The most common teaching method is the lecture. The general concession is that it may be most efficient for transmitting information (Kozma, 1978).

A lecture should present new or additional material not covered in the textbook if it is to be beneficial. The material should have excellent organization and language clarity if it is to be readily understood (Kozma, 1978). The plans should be simple and the examples abundant. All significant generalizations should be well developed with various kinds of interesting examples and research, all of which should be carefully documented. Facts and opinions should be clearly distinguished (Kozma, 1978).

The lecture method has several advantages. The lecture allows the instructor to compress a large amount of supplementary material into a short space of time and to emphasize and dramatize the most important points of his subject (Kozma, 1978).

The disadvantages of the lecture are also major. The primary drawback of the lecture is that it is essentially a unidirectional mode of communication. The listening student, in most cases, has little opportunity to influence the nature, rate, and flow of information. The only control the learner can exercise is to ignore it or turn it off. One-way communication offers little in the way of interaction and feedback, which are crucial for learning. If used excessively, as is too often the case, the lecture encourages intellectual passivity, the opposite of learning (Kozma, 1978).

This deleterious effect can be moderated by incorporating forms of interaction into the lectures. Posing questions, even if only rhetorical, can maintain student attention.

Other drawbacks of the lecture are less easy to counteract. The lecture, as a verbal medium, allows the student no direct experience with the body of knowledge. Although the instructor transmits the subject matter to the students, she may simultaneously serve as a barrier. Not only is it difficult for the student to interact with the lecture, it is also difficult for the student to interact with the discipline--to see what it looks like, how it feels, how it changes when acted upon, etc. As a result, the lecture fails to encourage creativity and problem solving (Kozma, 1978).

A final disadvantage of the method is its poor effect on retention. Students frequently forget, or never learn, much of what is said. This problem is more pronounced for longer lectures. In a study conducted by Joseph Trenaman, an audience listening to only the first 15 minutes of a lecture retained 41 percent of what was presented. Those listening to 30 minutes of the lecture remembered 23 percent of the material presented in the first 15 minutes; those listening for 45 minutes remembered only 20 percent. Thus, while the lecture is an inexpensive and easy way to deliver information to students, it is not very efficient. Only a small portion of the total lecture time can be used effectively for learning (Kozma, 1978).

TEXTBOOKS

In higher education, textbooks are the focus of learning. They are both instructional tools and objects of study. Their importance is illustrated by the fact that there is hardly a course, no matter the field, no matter how specialized or advanced, for which a textbook has not been written. The occasional professor who does claim that there is no book for a course, usually follows by announcing the forthcoming publication of one, for the writing of a book is a high point in the career of any scholar (Kozma, 1978).

Thus, it can be seen that a book, unlike a lecture, is an active medium, requiring the student's continual engagement in order for the message to be transmitted. It differs, however, from discussion in that it is not interactive. The potential for the student to alter the message to fit his or her needs is limited to the search or review of some useful subset of the material that is available. The learner cannot request information or pursue questions that do not fall within the content of the book (Kozma, 1978).

An essential feature of textbooks, as noted earlier, is that they are frozen. Unlike discussions, or even lectures, their messages are relatively stable and enduring, and as such they can be reliably delivered to all. Because of their stability they can be easily tried out, evaluated, and revised. This malleability is limited to a certain prepublication phase of print; for, once released, books are difficult to modify (an important limitation when the expected half-life of knowledge in some disciplines is five years) (Kozma, 1978).

The book puts a burden on the learner as well. The reception of a book's message depends on the reader, and the single greatest source of failure to learn is the failure to read effectively. Another burden is imposed by the fact that a printed statement cannot encompass all aspects of an idea. It cannot completely delimit and specify its potential interpretations. As such it simplifies experience (maybe overly so), and it allows--requires--the reader to use imagination to complete the message. This, however, is a burden not uncommon to most media (Kozma, 1978).

While the book requires the active involvement of the learner, it is not interactive. That is, the student cannot mold or shape the direction of his or her investigation beyond the domain of the text's message. Unlike discussion, the student is limited to the content of the text, and can modify it only to the extent that he or she can select some smaller portion which is relevant to the goal of learning (Kozma, 1978).

HANDOUT SHEETS

Perhaps more of a supplement than a special method of teaching is that of furnishing the student with printed reinforcement of the instructor's oral communication. Handout sheets are usually an expression of the instructor's determination to provide the student with a maximum of support for the lecture or other communicative methods of learning.

Handouts, when used, should be well organized and clearly structured in language. They should be relatively brief. They should be presented to the student at the proper time during the course (Kelly, 1970). For example, several biosynthetic and metabolic pathways are presented in the topics, proteins and endocrinology. Handouts of these pathways can be used to supplement the instructional technique.

STUDENT REPORTS

Student reports allow the student to be the focal point of class attention. Student reports include various advantages: they introduce a change of pace and voice; they allow each student to concentrate his study on one area of the course; they structure the class so that each student receives a series of other student reports in exchange for his own (Kelly, 1970).

Some potential disadvantages of student reports: the student who is poorly prepared wastes class time as well as his own; even if well prepared in content, the student's vocal and physical delivery may bore or distract the class from the real values of the report; the report may be only busy work, not contributing significantly to the course goals. In spite of these possible weaknesses, student participation by the report method is an excellent learning device which should be useful for almost any course in the curriculum (Kelly, 1970).

STUDENT PAPERS

This method is especially useful when there is a lack of class time for oral presentation. Student papers help every instructor evaluate the total student and his learning. In addition, papers can motivate learning by forcing the student to explore a given area and formulate conclusions of his own (Kelly, 1970).

STILL PROJECTION MEDIA

Still projection media such as slides, filmstrips, overhead transparencies, and the chalk board are most often used in conjunction with lecture presentation.

Since all projected media require some handling of equipment, instructors need to feel at ease with projectors. Still projectors are simple to operate, in general, but are occasionally subject to mechanical failures (Kozma, 1978).

An optimum projection environment takes several variables into account in order to facilitate the projection of instructionally retrievable images which are easily viewed by all students in the audience area (Kozma, 1978).

While in any given situation, proper image size will depend on the nature of the visual being projected, a rule-of-thumb is that the image width should be no smaller than 1/6 the distance between the screen surface and the last row of seating. For a normal classroom, this might be 5 - 6 feet. For a large auditorium, it might be 15 - 20 feet. Students should not sit closer than two images width from the screen. Under optimum conditions, they should sit directly in front of the screen, but they can normally be seated at up to a 45 degree angle to the screen without adverse effects. Individual student sightlines to the projected image should be clear, and seating should be comfortable. The room should be darkened sufficiently to permit good contrast and color saturation in the image. Normally, this is possible while retaining a light level which is adequate for note taking (Kozma, 1978).

OVERHEAD TRANSPARENCIES

Overhead transparencies are used primarily for the projection of printed or graphic information. The overhead projector may be used for spontaneous presentation of information by writing directly on transparencies in front of the class. Overhead transparencies can be prepared in advance and can be reused. The presentation lends itself to be a partially lighted room for note taking and with the instructor in front of the class to retain eye contact (Kozma, 1978).

To prepare transparencies ahead of time, the faculty member may work directly on acetate with overhead pens, or prepare masters for producing transparencies.

In general, overhead transparencies should be kept simple. The use of bold lettering and color emphasizes content. The instructor can also use overlap and combine prepared transparencies with spontaneous underlining, pointing or cueing with marking pens.

Projection for overhead transparencies should meet normal standards for image size, brightness, viewing angles, etc. (Kozma, 1978).

FILMSTRIP/SOUND PRESENTATION

Filmstrips have a fixed sequence, are very convenient to store, and are not very expensive. Filmstrips are capable of presenting pictorial, graphic, and printed content, and can be used with audiotapes, and programmed for automatic projection (Kozma, 1978).

CHALKBOARD

The chalkboard more than any other device can be identified with traditional teaching in higher education. It is used with large and small groups alike to present information, to solve problems, to outline points made in a lecture, to present diagrams, graphs, and charts, and to summarize discussions (Kozma, 1978).

The applications are endless. The chalkboard has many real advantages in the spontaneous presentation of written and graphic information. It is completely within the control of the instructor. As long as the chalk can be found, it always works. Material written on the chalkboard will almost certainly be copied into student's notebooks. But it also has severe limitations. Presentation of the material depends on the instructor's printing and drawing skills. It is for the most part impossible to prepare in advance. Presentations cannot be reused. It cannot be used to present pictures. Since lettering on a chalkboard has to be large and bold to be visible, chalkboard space is at a premium in most classrooms and auditoriums (Kozma, 1978).

DISCUSSION:

Except for lectures and textbooks, small group discussion is the most widely used technique in higher education. It plays an important role in classroom teaching, for while lectures and texts impart information, discussion allows the student to become actively involved in learning. While lectures requires the student to listen, discussion allows him to question, probe, and respond (Kozma, 1978).

Discussions are typically of two sorts: instructor-centered and student-centered. This division is based on the instructor's role in the discussion and the amount of structure provided (Kozma, 1978).

The instructor-centered discussion, as the term implies, focuses group attention on the teacher. The students may control the agenda and pace of the discussion, but the principal source of information is the instructor. This form of instructor-centered discussion is common before mid-terms and finals, for it gives the students a chance to ask questions and clear up misunderstandings (Kozma, 1978).

The questions do not have to originate with the students in an instructor-centered discussion. The professor can serve as the focus by asking a logical series of questions in Socratic fashion, leading to a predetermined solution (Kozma, 1978).

Finally, an instructor-centered discussion can take the form of a recitation. In recitation the instructor asks convergent subject matter questions usually based on the assigned readings or lecture. The instructor calls on students to give answers in what amounts to an oral quiz. With all three of these versions the instructor is the source of information and the adjudicator of truth (Kozma, 1978).

The student-centered discussion increases student talk time and diminishes the role of the instructor. Questions and comments are directed to other students more than to the instructor. The responsibility of the discussion is turned over to the learner, and, as a result, the students become more active and directive in their own learning. There are two models of student-centered discussion which are not mutally exclusive. In the problem-solving mode, students are given a question or problem and must rely on their own resources and ingenuity to come up with an answer or answers. The role of the instructor is limited to setting the task (although another opinion would be to let the group set the task). The group decides how it will reach its solution (Kozma, 1978).

The second mode of student-centered discussion is the open-ended discussion. The primary purpose of this mode is to have students share experiences, feelings, and opinions about a topic or issue without concern for resolution. These modes can complement each other by using the open-ended mode to clarify positions on an issue and then moving to the problem-solving mode to resolve the difference (Kozma, 1978).

With either mode, students are the source of information. They may bring diverse experiences and perspectives to bear on a common problem, or present a range of reactions to a shared experience, such as a reading, film, or game.

Probably the greatest advantage of discussion, at least over lecture, is that it is responsive to student needs. If a student misunderstands and needs clarification, requires an illustration of a point, or would like one position compared with another, all she need

do is ask. Thus, the student becomes actively involved in learning, seeking out information and opinions (Kozma, 1978).

He also has an opportunity to respond; he can share his position as well. He can nod his consent, raise an objection, or contribute new ideas and attitudes to the discussion (Kozma, 1978).

This interaction among students presents the group with a variety of perspectives, opinions, and options, a condition which can lead to the students' personal development (Kozma, 1978).

The basic problem with discussion is that it is very unreliable. Apart from the times when it may become aimless or boring, it is usually haphazard even when done well. That is, because discussion is a less structured activity, not all of the important points may be raised, nor all of the information be accurate, nor all of the students' needs met (Kozma, 1978).

Although Hill (1969) presents a systematic discussion procedure which may alleviate this problem, a discussion is very much what the students make it, even when the instructor is an able and experienced group leader (Kozma, 1978).

Another problem with discussion is that a significant amount of class time is required to maintain the group. This is particularly true for the first several class periods, when the group is in its early stages of development. Students are primarily interested in getting to know each other and learning how to function as a group. This tends to be a less productive, low task-oriented period, but can be an important process if the goals for the course are the acquisition of interpersonal skills (Kozma, 1978).

Skills necessary to make a discussion a productive and enjoyable instructional experience are covered in the following paragraphs:

Starting. The way the instructor begins the discussion is critical. If it is done correctly, the students will know what is expected of them, will understand the rules of discussion, and will feel comfortable in expressing opinions, doubt, or ignorance. If done poorly, the start of a discussion can be its finish. The instructor can affectively close off discussion and make students feel defensive and threatened (Kozma, 1978).

The instructor should begin by stating the objective or goal of the discussion session. This can be done by asking an open-ended question, stating a problem, or describing a potential outcome of the discussion. The task should be written on the board, along with any rules of discussion that the instructor might find appropriate for the occasion (e.g., "criticism suspended for the first ten minutes"; "always give evidence to support your position"), and a termination time. The instructor should avoid asking questions that have only one answer, giving her opinion, or stating the question too broadly (e.g., "what do you think of the movie we just saw?) (Kozma, 1978).

After stating the question, the instructor can walk away from an experienced group, leaving the students to their own resources. With less experienced groups, however, the instructor will have to be more directive. She should wait for a voluntary response to the question (while silently counting to ten), before tactfully directing the question specifically to one of the members. From this point on, the instructor should withdraw until one of the other leadership functions must be served (Kozma, 1978).

Contracting. An optional function of the instructor is to involve the students in constructing a group "contract". This is more important in an ongoing discussion group than for an ad hoc discussion. The instructor should get the group members' opinions as to what will be the goals, roles (i.e., what is expected of the instructor and members), criteria (i.e., how the group will know when goals are met), and reward (i.e., what the members will get out of the group). Goals can be elicited using a technique called "problem posting". The instructor can ask the group what problems should be addressed by the group, and list without evaluation, all suggestions. This list can serve as the group's agenda for the term. It is important for that group to know that it can rewrite its contract at a later time (Kozma, 1978).

PROGRAMMED INSTRUCTION

Programmed instruction is a prime example of an instructional technique for which the claims far exceeded the realizations.

It was B.F. Skinner (1954), who introduced programmed instruction through an article in the "Harvard Educational Review". According to Skinner, complex learning occurs through a series of attempts or trials at a task by the learner. Trials which are successful and which are immediately followed by some positive consequence or reinforcement are repeated in the future. Attempts which are not reinforced are extinguished. Skinner suggested that learning starts with rather simple behaviors which in some way approximate the more complex behavior. As successful trials on the simple task occur and are reinforced, slightly more complex behaviors can be successively introduced until the final behavior is achieved (Kozma, 1978).

The essential characteristics of programmed texts are:

1. A logical sequence of small steps. Students are led through a presentation of small amounts of information sequentially arranged to progressively approximate the final complex behavior.
2. Active response. The student is asked to operate on the information in an appropriate way. Typically the student must complete a sentence with the appropriate word or answer a question.
3. Immediate feedback. The student is reinforced by being given the correct answer as soon as the response is completed.
4. Individual rate. Each learner is allowed to progress through the sequence at his or her own rate. Thus, programmed

instruction accomodates individual differences in ability, not by teaching less but by varying pace (Kozma, 1978).

Although there are still traditional programs in use, the "frames" of the many recent programs are larger. Thus, a student may read anywhere from a page of text to a whole chapter before making a response. The responses may also be more complex. Instead of filling in a missing word, the student may write a brief essay, conduct a project, or perform a simulated task. The sequences are more complex as well. Instead of moving through the information in a linear fashion, students may be branched into remedial lessons or around material to more advanced units depending on their responses (Kozma, 1978).

Because programmed instruction was designed specifically for sequential learning, it has several features which give it advantages over other techniques. The self-pacing allows for differences in rate of learning between students. The immediate feedback verifies student learning, avoids mislearning, and allows for quick and penalty-free adjustment to error.

The active responding engages students in learning. These responses are limited, however. Programmed instruction is not as interactive as a discussion; the student, for the most part, is not able to alter the scope or sequence of the learning. Nor are the responses usually as complex as in more interactive modes. Programs which are limited to requesting students to fill in missing words sometimes appear uninteresting (Kozma, 1978).

The fact that programmed instruction is a stable and enduring form of instruction allows the instructor to modify and revise the program until it is effective and efficient (Kozma, 1978).

Research has shown that program instruction is as effective and efficient as traditional instruction (Kozma, 1978).

INSTRUCTIONAL TECHNIQUES AND OBJECTIVES FOR THE TOPICS IN CLINICAL CHEMISTRY

The following sections include instructional and student behavioral objectives, a brief overview, and the suggested techniques and methods for each of the eleven subjects or topics in clinical chemistry.

TOPIC 1

QUALITY CONTROL

Clinical chemistry laboratories produce data that are used to aid in making clinically important decisions. All data generated are associated with variations that interfere with data evaluation and interpretation.

The refinement of laboratory techniques and the application of better experimental design procedures are essential in reducing variation. Statistical methods are helpful in providing estimates of and controlling the variations which remain.

Instructional Objectives:

1. Discuss the origin and necessity of quality control in the laboratory.
2. List the four necessary conditions required for an efficient quality control program.
3. Define the following terms:
   a. arithmetic mean
   b. median
   c. degree of freedom
   d. outlier
4. Explain the three control charts.
5. Explain the calculation of standard deviation and range.
6. Explain the procedure for establishing a control chart.
7. List four rules that show how quality control serves advantageously for the laboratory.

Student Objectives:

The student will be able to:

1. State the origin of quality control in the clinical laboratory.
2. List three of the necessary conditions required for an efficient quality control program in the clinical laboratory.
3. Define the following terms:
   a. arithmetic mean
   b. median
   c. degree of freedom
   d. outlier
4. Identify the three control charts.
5. Calculate a standard deviation and range.
6. Construct a control chart.
7. List four rules that show how quality control serves advantageously for the laboratory.

Instructional Techniques:

Lecture

The importance of an efficient quality control program and the necessary factors that constitute one is presented in the lecture. These factors include the definition and explanation of statistical concepts.

Transparancies

This technique is used to supplement the lecture. Transparancies of the three control charts present a more visual explanation of the information.

Chalkboard

The chalkboard is also used as a supplementary medium. It is used for the explanation of statistical computations mentioned in the lecture.

TOPIC 2

CARBOHYDRATES

Carbohydrates are the major food supply and energy source for the people of the world. Despite the major utilization of carbohydrates for energy, only a small amount is stored in the body.

The most common disease related to carbohydrate metabolism is diabetes mellitus, which is caused by insufficient blood levels of active insulin and characterized by high blood glucoses.

The determination of the blood glucose level is the most frequently performed procedure in the clinical chemistry laboratory. Various procedures and methods are used for the blood glucose determination.

Instructional Objectives:

1. Define carbohydrate.
2. Give the classification and an example of the different carbohydrates.
   a. monosaccharides
   b. disaccharides
   c. polysaccharides
4. Define the following terms applied to carbohydrate metabolism.
   a. glycogenesis
   b. glycogenolysis
   c. gluconeogenesis
   d. glycolysis
5. Discuss the effect of the following hormones in the regulation of blood glucose concentration.

a. insulin

b. hydrocortisone

c. epinephrine

d. glucagon

e. thyroxine

f. sommatostatin

6. Explain and differentiate the clinicopathological correlation of glucose metabolism.

a. hypoglycemia

b. hyperglycemia

7. Discuss the pathological state diabetes mellitus.

a. explain the etiology

b. list three clinical findings

c. list three laboratory findings

d. explain possible prognosis

8. Explain the following principles of methods for glucose determination.

a. enzymatic

b. oxidation

c. colorimetric condensation

9. Explain and discuss the three types of glucose tolerance curves.

Student Objectives:

The student will be able to:

1. Define the term carbohydrate.

2. List and give an example of the three classifications of carbohydrates.
3. Demonstrate an understanding of carbohydrate metabolism.
4. Define the following terms applied to carbohydrate metabolism.
   a. glycogenesis
   b. gluconeogenesis
   c. glycolysis
   d. glycogenolysis
5. State the effect of three of the hormones in the regulation of blood glucose concentration.
6. Differentiate the two terms, hypoglycemia and hyperglycemia.
7. Demonstrate an understanding of the condition, diabetes mellitus in relation to its etiology, clinical and laboratory findings, and prognosis.
8. State the principle of four specific methods for glucose determination.
9. Identify three glucose tolerance test curves.

Instructional Techniques:

Lecture

The lecture is used to introduce and present information concerning the relation of carbohydrate metabolism to the factors that regulate blood glucose levels, the clinicopathological condition diabetes mellitus, and principles of methods of determination for glucose.

Since many of the topics in clinical chemistry involve specific aspects of carbohydrate metabolism, the lecture will serve to present information which will be used for the explanation of other topics.

Chalkboard

Any of the information which requires more than an oral presentation is enhanced with the chalkboard. Structures, outlines of information, and reactions are further emphasized with the chalkboard.

Textbooks

Specific chapters on carbohydrate metabolism are used to further supplement the lecture. The chapters present explanations and information concerning diabetes mellitus and the history of glucose testing.

TOPIC 3

NONPROTEIN NITROGEN COMPOUNDS

The nonprotein nitrogen (NPN) fraction of blood is composed of the nitrogen present in all nitrogenous compounds other than protein or amino acids. Urea nitrogen (BUN), the major NPN component, and several other nitrogenous compounds comprise the NPN compounds.

Renal conditions are usually diagnosed and evaluated by the various levels of these NPN compounds. Therefore, specific tests must be available for all of the compounds to aid in the evaluation of renal or other clinical conditions. In addition, three renal function tests are a means of diagnosing and evaluating renal condition.

Instructional Objectives:

1. Define nonprotein nitrogenous compounds.
2. List and give the blood concentration of the NPN substances.
   a. urea nitrogen
   b. amino acids
   c. uric acid
   d. creatinine
   e. creatine
   f. ammonia
3. Discuss urea nitrogen.
   a. explain its chemistry
   b. explain its clinical significance
   c. explain the three factors that may cause an increased BUN
   d. discuss two principles of methods of determination

4. Explain the difference between creatine and creatinine.
   a. discuss the clinical significance
   b. state and explain two principles of methods of determination
5. Discuss uric acid.
   a. explain clinical significance
   b. explain two principles of methods of determination
6. Discuss ammonia.
7. Define clearance test.
8. Explain the three renal clearance tests.
   a. urea
   b. inulin
   c. creatinine
9. Explain the calculation of the three renal tests.
10. Explain application of renal function tests.

Student Objectives:

The student will be able to:

1. Define the term nonprotein nitrogenous compounds.
2. List and give the blood concentrations of five of the NPN compounds.
3. State the chemistry and clinical significance of urea nitrogen.
4. List three factors which may elevate the blood urea nitrogen.
5. State one principle of a method for the determination of BUN.
6. Differentiate between the terms, creatine and creatinine.

7. State the clinical significance of creatinine.
8. State the principle of two methods for creatinine determination.
9. State clinical significance of uric acid.
10. State the principle of two methods for uric acid determination.
11. Demonstrate an understanding of the three renal clearance tests.
12. Calculate the results for three renal clearance tests.
13. State a general application of two of the renal function tests.

Instructional Techniques:

Lecture

The lecture is used to explain the several components of the blood classified as nonprotein nitrogenous (NPN) compounds. The chemistry, functions, methods of determination, and clinical significance of NPN compounds are also explained in the lecture.

The concepts and information presented about the NPN compounds are important in the relation to other topics. The information presented in the lecture is necessary for the understanding of renal function tests. Several NPN compounds are important factors in the renal function tests.

Chalkboard

The chalkboard is used in any situation when an oral explanation is not sufficient. Although it is used basically to emphasize any information mentioned in the lecture, specific uses are the explanation of the calculation of clearance test and the explanation of reactions for methods of determination.

Textbooks

The textbooks contain specific information on the NPN components, urea nitrogen and creatinine. This information can clarify or reinforce the information presented in the lecture.

TOPIC 4

PROTEIN

Plasma proteins have diverse functions. They may function as enzymes, antibodies, or as transport media. They also serve a nutritive role, maintain acid base balance, and regulate osmotic pressure. These diverse functions can be a characteristic of one fraction or a concerted one.

Electrophoresis allows one to examine the total protein and the five individual fractions. Any clinical condition associated with an abnormal level of any or all of the fractions can be examined with electrophoresis.

Instructional Objectives:

1. Define protein.
2. Explain the structure of proteins.
   a. primary
   b. secondary
   c. tertiary
   d. quaternary
3. Explain the classification of plasma proteins.
4. Explain six functions of plasma proteins.
5. List and discuss three characteristics of the protein fractions.
   a. albumin
   b. alpha 1
   c. alpha 2
   d. beta
   e. gamma

6. List the five immunoglobulins.
7. Explain the basic structure of the immunoglobulin.
8. Explain clinical significance of the immunoglobulins.
9. Explain two methods of determination for proteins.
10. Define electrophoresis.
11. Explain the interpretation of several electrophoresis patterns.
    a. beta-gamma bridge
    b. monoclonal and polyclonal gammopathy
12. Discuss macroglobulins.
13. Discuss cryoglobulins.

Student Objectives:

The student will be able to:

1. Define the term protein.
2. Construct the basic structure of proteins.
3. List four classifications of proteins.
4. List four functions of plasma proteins.
5. State two characteristics of each of the plasma protein fractions.
6. Draw the basic structure for the five immunoglobulins.
7. State the clinical significance of the immunoglobulins.
8. State the principles of two methods of determination of proteins.
9. Interpret six electrophoretic patterns.
10. Demonstrate an understanding of macroglobulins.
11. Demonstrate an understanding of cryoglobulins.

Instructional Techniques:

Lecture

The lecture is used to explain and identify the function of the plasma proteins. Identification and evaluation of the protein fraction with electrophoresis is presented in the lecture.

Electrophoresis, a procedure that can be used for identification and evaluation of the total protein and the fractions, is explained in the lecture.

Methods of total protein determination and other serum proteins are presented in the lecture.

Chalkboard

As a supplementary medium, the chalkboard is used to demonstrate protein and immunoglobulin structures and to emphasize or clarify points mentioned in the lecture.

Overhead Transparencies

The transparencies are used as a visual support for the lecture on electrophoresis. The electrophoretic patterns of different clinical conditions are demonstrated with transparencies.

Handout sheets

To further supplement the lecture on electrophoresis, prepared handouts of electrophoretic patterns similar to the transparencies are used.

Textbooks

The chemistry of plasma proteins and the various clinical electrophoretic patterns are explained in the textbooks. These explanations may serve as additional information or as a means of clarification.

TOPIC 5

ELECTROLYTES

Electrolytes are classified as either anions or cations, depending upon whether they move in an electric field toward the anode or the cathode, that is, whether they have a negative or positive charge. They are essential components of all living matter and their role in the human body is manifold. The various levels of electrolytes are usually associated with certain clinicopathological conditions.

Methods of determination vary from colorimetric to flame photometry, each with its own special merits and limitations.

Instructional Objectives:

1. Define electrolyte.
2. Differentiate the following:
   a. cation
   b. anion
3. Discuss the following cations in relation to function, clinical significance and method(s) of determination.
   a. sodium
   b. potassium
   c. magnesium
   d. calcium
   e. phosphorus*
4. Discuss the following anions in relation to function, clinical significance and method(s) of determination.
   a. chloride

* anion

b. bicarbonate

c. sulfates

d. ketone bodies

5. Explain the cation-anion electroneutrality phenomenon.

6. Explain iron and iron binding capacity in relation to function, clinical significance and method of determination.

Student Objectives:

The student will be able to:

1. Define electrolyte.

2. Differentiate the terms anion and cation.

3. State the clinical significance, function, and methods of determination of the following cations.

   a. sodium

   b. potassium

   c. magnesium

   d. calcium

   e. phosphorus*

4. State the clinical significance function and methods of determination of the following anions.

   a. chloride

   b. bicarbonate

   c. sulfates

   d. ketone bodies

5. State clinical significance, function and method of determination for iron and iron binding capacity.

* anion

Instructional Techniques:

Lecture

The classification of electrolytes, their functions, clinical significance, and methods of determination are explained in the lecture. The information presented in the lecture is used in other topics in clinical chemistry.

Textbooks

Specific information on iron metabolism is presented in the textbooks. This information is used for further explanation or clarification.

Chalkboard

Specifically the chalkboard is used to demonstrate the calculation of the anion gap, but it can also be used to emphasize any important points. It is also used to outline the classification of the electrolytes and to explain my reactions.

TOPIC 6

ACID BASE BALANCE

A description of the acid-base balance involves a description of the CO_2 balance as well as the balance of non-carbonic acid and base. The acid base status of the body fluids, the concentration of titratable acid or base, and other acid-base variables are the resultant of the input and output of acids and bases.

Various clinical conditions are associated with abnormal acid base status of the body fluids. Sensitive methods of determination for the blood pH and pCO_2 must be used to monitor the conditions closely.

Instructional Objectives:

1. Explain acid base balance.
2. List and explain the three buffer systems in relation to their roles in regulating the pH of body fluids.
3. Explain the Henderson-Hasselbalch equation.
4. Define the following in relation to acid base balance.
   a. pCO_2
   b. pH
   c. CO_2 content
   d. alkalosis
   e. acidosis
5. Explain the role of the following two systems in regulation of acid base balance.
   a. renal
   b. respiratory

6. Discuss the conditions respiratory and metabolic alkalosis in terms of etiology, symptoms, and treatment.
7. Discuss the conditions respiratory and metabolic acidosis in terms of etiology, symptoms, and treatment.
8. Discuss five clinical conditions associated with the four acid base abnormalities.

Student Objectives:

The student will be able to:

1. List and explain three buffer systems of the body fluids.
2. State the Henderson-Hasselbalch equation.
3. Define the following terms related to acid base balance.
   a. pCO_2
   b. pH
   c. CO_2 content
   d. alkalosis
   e. acidosis
4. State the role of the renal and respiratory system in acid base balance in the body.
5. Differentiate the conditions respiratory and metabolic acidosis in terms of etiology, symptoms, and treatment.
6. Differentiate the conditions respiratory and metabolic alkalosis in terms of etiology, symptoms, and treatment.
7. Identify a specific condition as one of the four acid base abnormalities.

Instructional Techniques:

Lecture

The lecture is used to present and explain the roles of the three buffer systems, the related terms, and the role of the renal and respiratory systems in acid base balance of body fluid. This information is further used to explain the clinicopathological conditions associated with acid base balance.

Chalkboard

The chalkboard is used to demonstrate and explain mathematical computations, specifically pH.

The chalkboard is also used to emphasize points and to outline points in the explanation of the four conditions associated with acid base abnormalities.

Textbooks

The textbooks contain specific information on the role of the renal and respiratory systems in acid base balance. This information is used to further explain the information mentioned in the lecture.

TOPIC 6B

BLOOD GAS ANALYSIS

Instructional Objectives:

1. Explain the procedure for proper collection of blood gas specimen.
2. Explain the components of the blood gas analyzer.
3. Discuss the processing of a blood gas specimen.

Student Objectives:

The student will be able to:

1. Demonstrate an understanding of the proper collection of a specimen for blood gas determination.
2. List and describe three of the components of the blood gas analyzer.

Instructional Techniques:

Lecture

The lecture is used to explain and emphasize the blood gas analysis. This information includes collection, preservation, and determination. The operation of the blood gas analyzer is also explained.

Filmstrips

Collection of blood gas specimens and the operation of the blood gas analyzer are demonstrated with a filmstrip. This filmstrip is used to demonstrate the concepts mentioned in the lecture.

Handout sheets are used to present a more visual representation of the collection and analysis of blood gas specimens.

TOPIC 7

ENZYMES

Clinical enzymology is the application of the science of enzymes to the diagnosis and treatment of disease processes. This topic outlines the main features of enzyme chemistry and surveys the principles which govern enzyme assay methods. Procedures used to assay enzyme activity are related to the choice of enzyme.

Instructional Objectives:

1. Define enzyme.
2. Define and illustrate the following two terms.
   a. zero order kinetics
   b. first order kinetics
3. List six factors governing enzyme activity, i.e., rate of reaction.
4. Define isoenzyme.
5. Define international unit.
6. Explain the five classifications of diagnostic enzymes.
   a. isomerases
   b. tranferases
   c. oxidoreductases
   d. hydrolyases
   e. lyases
7. Discuss the phosphatases in relation to function, location, clinical significance, and principle of method(s) of determination.

8. Discuss the enzyme amylase in relation to function, location, clinical significance, types and methods of determination.
9. Discuss the enzyme lipase in relation to function, clinical significance, and methods of determination.
10. Discuss the function and clinical significance of cholinesterase.
11. Discuss the function and clinical significance of ceruloplasmin.
12. Discuss lactate dehydrogenase in relation to its function, clinical significance, the isoenzymes, and methods of determination.
13. Explain the two transaminases--aspartate transaminase (AST) and alanine transaminase (ALT).
14. Explain the concentration of the two transaminases in different hepatic conditions.
    a. viral hepatitis
    b. toxic hepatitis
    c. cirrhosis
15. Explain the function, clinical significance, method of determination and the three isoenzymes of creatine kinase (CK).
16. Discuss the concentrations of different enzymes in various clinical states.

Student Objectives:

The student will be able to:

1. Define the term enzyme

2. Differentiate between zero order kinetics and first order kinetics.
3. List four of the six factors governing enzyme activity or rate of reaction.
4. Define isoenzyme.
5. Define international unit (IU).
6. State the four classifications of enzymes of diagnostic significance.
7. State the clinical significance, function, location, and method(s) of determination of the following:
   a. phosphatases
   b. amylase
   c. lipase
   d. cholinesterase
   e. ceruloplasmin
   f. lactate dehydrogenase (LDH)
   g. creatine kinase (CK)
8. Compare the isoenzymes of LDH.
9. List the two transaminases that are of clinical significance.
10. Compare and contrast the serum levels of the transaminases in two of the hepatic diseases.
11. State the three isoenzymes of CK.
12. Identify specific clinical conditions with abnormal blood enzyme concentrations.

Instructional Techniques:

Lecture

Diagnostic enzymology involves various enzymes of clinical interest, factors which influence activity, and methods of determination. The lecture is used to present and expand information concerning these factors.

Information presented in the lecture on diagnostic enzymology is also used in the topic, hepatic function.

Programmed Study

This technique is used for the study of specific enzymes, e.g., amylase, lactate dehydrogenase. A program or frame of the different enzymes consists of the following information: chemistry of the enzymes, clinical significance, and methods of determination.

Chalkboard

The chalkboard is used to emphasize, if needed, any information concerning diagnostic enzymology. Illustrations of zero and first order kinetics are done with the chalkboard.

Transparencies

Illustrations of the cardiac enzymes in the clinical condition myocardical infarction is a specific example of the use of transparencies. The information concerning the cardiac enzymes is explained in the lecture; thus the transparencies present a visual presentation of the information.

Transparencies are also used to illustrate the activity of various enzymes in other clinicopathological conditions.

Textbooks

Information on enzyme activity, methods of determination, and clinical correlations are explained in the textbooks.

Discussion

Many clinicopathological conditions are associated with abnormal enzyme activity. In the lecture technique, these conditions are only mentioned in relation with the specific enzyme. The discussion technique is used to fully explore these clinicopathological conditions.

TOPIC 8

HEPATIC FUNCTION

The liver is the major site of intermediary metabolism, synthesis of many important compounds, site of conjugation and detoxification of natural and potentially toxic foreign substances, and the site of glycogen storage. These characteristics and functions of the liver make it a very important organ.

Various tests and procedures are used for evaluation of hepatic function. These procedures include enzyme analyses, total protein electrophoresis, and foreign substance excretion tests.

Instructional Objectives:

1. Describe the gross anatomy of the liver.
2. List three common functions of the liver.
3. Explain bilirubin metabolism.
    a. define the following terms in relation to bilirubin metabolism
        (1) glucoronyl transferase
        (2) uridine diphosphate glucuronate
        (3) conjugated bilirubin
        (4) unconjugated bilirubin
        (5) urobilinogen
        (6) stercobilinogen
4. List four properties of indirect or direct bilirubin.
5. Explain the clinical condition jaundice.
6. List the three types of classifications of jaundice.
    a. prehaptic

b. hepatic

c. posthepatic

7. Explain the predominant type of bilirubin, possible causes, and distinguishing tests for each classification.
8. Discuss the clinical condition pathological neonatal jaundice.
9. Define and list two probable causes of kernicterus.
10. Explain the early two methods of determination of bilirubin.
11. List and explain the significance of the following test methods for the evaluation of hepatic function.
    a. icterus index
    b. serum bilirubin - methods
    c. urine urobilinogen
    d. carbohydrate metabolism test
    e. protein metabolism test
    f. flocculation test
    g. foreign substance excretion
12. Explain the four classifications of enzymes in relation to their behavior in hepatitis and obstructive jaundice.
13. Compare and contrast serum and infectious hepatitis in relation to etiology, clinical findings, pathogenicity, and methods of detection.

Student Objectives:

The student will be able to:

1. Describe the gross anatomy of the liver.
2. List two of the three functions of the liver.
3. State the metabolism of bilirubin.

4. Define five of the terms related to bilirubin metabolism.
5. List three properties of indirect or direct bilirubin.
6. Define and list the three classifications of jaundice.
7. For each classification of jaundice, list the predominant bilirubin type, possible causes, and distinguishing tests.
8. Define and list two probable causes of kernicterus.
9. State two of the methods used to determine bilirubin.
10. State the significance of four test methods used for the evaluation of hepatic function.
11. State the four classifications of enzymes in relation to their behavior in hepatitis and obstructive jaundice.
12. Compare and contrast serum and infectious hepatitis in relation to etiology, clinical findings, and pathogenicity.

Instructional Techniques:

Lecture

The lecture is used to explain and describe the liver, its numerous functions and associated clinicopathological conditions. Methods and procedures used to evaluate the liver are also explained in the lecture.

Chalkboard

As a supplementary medium to the lecture, the chalkboard is used to outline the bilirubin metabolism pathway. This technique enhances the information presented in the lecture.

Overhead Transparencies

Structure of hepatic related compounds and diagrams is explained with transparencies. Transparencies of biosynthetic and metabolic

pathways are also used to present a visual representation of the pathways.

Student reports or papers

Reports or papers are used to expand the information about several hepatic clinicopathological conditions. Many of the clinical conditions associated with hepatic metabolism are only mentioned in relation to their association with abnormal hepatic function. Specific reports of the clinicopathological conditions not only explain the hepatic involvement but, also, present a total clinical picture of the condition.

Discussion

The discussion technique is used interchangably with student reports. After completion of the specific reports, the discussion technique is utilized.

Since many of the clinicopathological conditions usually involve altered blood chemistries other than hepatic related ones, this technique will allow the student to correlate the results.

TOPIC 9

LIPIDS

Lipids can serve as structural and functional elements of biomembranes, as precursors to other essential substances, as a source of biochemical fuel, as energy storage depots, and as insulation.

The two major blood lipids, triglyceride and cholesterol, are usually transferred in the body in conjunction with a specific lipoprotein. These two lipids have diverse functions. Their blood levels are especially important in atherosclerotic disease.

Instructional Objectives:

1. Define lipid.
2. Discuss the two classifications of lipids.
3. Explain the four lipoprotein groups.
4. Explain the general metabolism of lipids.
5. List concentration of the four serum lipids.
6. Discuss the lipid constituent triglyceride, its lipoprotein association, metabolism, and methods of determination.
7. Discuss the lipid constituent cholesterol, its lipoprotein association, metabolism, and methods of determination.
8. List the five lipoproteins.
9. Explain the three techniques employed to characterize lipoprotein.
10. Define and differentiate primary and secondary hyperlipoproteinemia.
11. Discuss the three steps used to classify the hyperlipoproteinemia.

12. Explain the six familial hyperlipoproteinemia phenotypes established by Fredrickson.
13. Explain the clinical significance of each phenotype.
14. Describe the lipoprotein electrophoresis pattern for each phenotype.
15. Discuss the determination of the lecithin sphingomyelin (L/S) ratio in the amniotic fluid.
16. Explain three characteristics of lipid storage disease.

Student Objectives:

The student will be able to:

1. Define lipid.
2. State the two classifications of lipids.
3. State the metabolism of lipids.
4. List the concentration of four serum lipids.
5. State the lipoprotein association, metabolism, and principle of two methods of determination for triglycerides.
6. State the lipoprotein association, metabolism, and principle of two methods of determination for cholesterol.
7. List the five lipoproteins.
8. State the three techniques employed to characterize lipoproteins.
9. Define hyperlipoproteinemia.
10. Differentiate primary and secondary hyperlipoproteinemia.
11. List the three steps used to classify the hyperlipoproteinemias.

12. List the six familial hyperlipoproteinemias phenotypes established by Fredrickson.
13. State the clinical significance of each phenotype.
14. Describe the lipoprotein electrophoresis pattern for each phenotype.
15. State the significance of the determination of the lecithin spingomyelin (L/S) ratio in the amniotic fluid.
16. List three characteristics of lipid storage disease.

Instructional Techniques:

Lecture

The lecture is used to explain the functions, metabolism, and methods of determination of the two major blood lipids, triglyceride and cholesterol.

The term or concept hyperlipoproteinemia is introduced in the lecture. The lecture also explains and demonstrates the classification of the hyperlipoproteinemia phenotypes.

Handout sheets

Handouts are used to explain the biosynthetic and metabolic pathways of cholesterol and triglyceride. Illustrations of the five hyperlipoproteinemia phenotypes are also demonstrated with handouts.

Chalkboard

The chalkboard is used to illustrate reactions, structures, and other information concerning lipids.

Textbooks

Illustrations of the five phenotypes are presented in the textbooks. These visual representations enhance the information mentioned in the lecture.

TOPIC 10

ENDOCRINOLOGY

Endocrinology is a science that deals with the product of a group of glands and their actions in maintaining the chemical integrity of cell environment.

Hormones, protein substances secreted by these special glands, have functions which vary from carbohydrate metabolism to water and electrolyte balance.

Various tests and procedures are used to evaluate the specific hormones.

Instructional Objectives:

1. Define the term hormone.
2. Classify the three general functions of hormones.
3. List the fourteen organs that comprise the endocrine system.
4. Explain the mechanism of action and regulation of hormones.
5. Describe the location, structure, and function of the hypophysis.
6. List the ten hormones of the anterior and posterior pituitary gland.
7. Define the term steroid hormone.
8. Explain the biosynthesis of steroid compounds.
9. Explain the location and function of the adrenal gland.
10. Discuss the corticosteroid compounds.
11. Discuss the regulation of adrenocorticosteroid secretion.
12. List the three corticosteroid hormones of major biological significance secreted by the adrenal cortex.

13. Discuss the two classifications of adrenocortical steroid hormones.
14. Discuss three biological effects of the adrenocortical hormones.
15. Explain two methods of determination of corticosteroids.
16. Explain four conditions associated with abnormal corticosteroid levels.
17. Discuss the two hormones of the adrenal medulla.
18. Explain the clinical correlations of the following tests for adrenal medulla function.
    a. vanil mandelic acid (VMA)
    b. catecholamine
19. Explain the biosynthesis and clinical significance of serotonin.
20. Explain the nature, action, and clinical significance of the following gonadotropins:
    a. estrogen
    b. progesterone
    c. testosterone
    d. prolactin
    e. human chorionic gonadotrophin (HCG)
21. Describe the gross anatomy of the thyroid gland.
22. Discuss the functions of the thyroid gland.
23. Explain the action of the thyroid stimulating hormone (TSH).
24. Explain the biosynthesis, three functions, and two methods of determination for the following two thyroid hormones.

a. triiodothyronine (T_3)

b. tetraidothyronine (T_4)

25. Discuss three thyroid related diseases.

Student Objectives:

The student will be able to:

1. Define the term hormone.
2. Classify the three general functions of hormones.
3. List the fourteen organs that comprise the endocrine system.
4. Define negative feedback mechanism.
5. Describe the location, structure, and function of the hypophysis.
6. List the ten hormones of the anterior and posterior pituitary gland.
7. Define steroid compound.
8. State the biosynthesis of steroid compounds.
9. Describe the location and function of the adrenal gland.
10. Define the corticosteroid compounds.
11. State the regulation of adrenocortical secretions.
12. List the three major steroid hormones secreted by the adrenal cortex.
13. List the two classifications of adrenocortical steroid compounds.
14. List three other hormones besides the corticosteroids secreted by the adrenal cortex.
15. State three of the biological effects of the adrenocortical hormones.
16. State two methods for determination of corticosteroids.

17. Identify five conditions with abnormal corticosteroid levels.
18. List two hormones of the adrenal medulla.
19. State the clinical correlation of two tests used to evaluate medulla function.
20. State the biosynthesis of serotonin.
21. State the clinical significance of serotonin.
22. State the nature, action and clinical significance of the following gonadotrophins.
    a. estrogen
    b. progesterone
    c. testosterone
    d. prolactin
23. Describe the gross anatomy of the thyroid gland.
24. State three functions of the thyroid gland.
25. State the action of the thyroid stimulating hormone (TSH).
26. Describe the biosynthesis of the following two thyroid hormones.
    a. triiodothyronine (T-3)
    b. tetraidothyronine (T-4)
27. Describe two functions of T-3 and T-4.
28. State the method of determination for T-3 and T-4.

Instructional Techniques:

Lecture

Endocrinology is really a discipline of itself. Most of the information in this topic is rather complex. Since this topic involves several different hormones, their functions, clinical significances,

and methods of determination, a complete study of the individual hormones involves a general understanding of endocrinology.

The lecture is used to present the following information which is used for further study of the individual hormones: a definition of hormone, organs that comprise the endocrine systems, and the mechanism of action and regulation of hormones.

The lecture is also used to explain or present the information concerning the individual hormones.

Handout sheets

The study of endocrinology involves several biosynthetic and metabolic pathways. Handout sheets are used when more than an oral presentation of the information is required.

Programmed Study

This technique is used as a co-instructional technique along with the lecture. As mentioned in the lecture technique, the study of the individual hormones depends on a general understanding of endocrinology. A program of frame(s) dealing basically with general endocrinology is very beneficial as an introduction to the topic.

A program or frame(s) of the different hormones is also used.

Discussion

The discussion technique is used for the case histories or other problem solving activities. Many clinical conditions associated with endocrine function involve several other clinical features. This technique allows for the total evaluation of the clinical condition.

Textbooks

Illustrations of the negative feedback mechanism, biosynthetic and metabolic pathways of the various hormones, and structures of the

hormones are presented in the textbooks. This information is used for further explanations and clarifications of the topics.

TOPIC 11

TOXICOLOGY

Clinical toxicology generally has two main functions. The first and most obvious function is the identification and quantification of toxic substances. The second general function is to monitor certain chemical substances in patients.

Employing specific and reliable procedures for the detection of drugs allows quick and accurate results which may be life saving.

Instructional Objectives:

1. Define toxicology.
2. Discuss the desired specimen for toxicological analysis.
3. Discuss the effects of alcohol.
4. Explain the clinical significance of ethanol in relation to metabolism.
5. List the required specimen for ethanol analysis.
6. Explain the principle of method of determination.
7. Explain interpretation of blood ethanol results.
8. Explain significance of methanol in relation to metabolism.
9. For the following drugs, explain clinical indications and correlations, metabolism, specimen, method of determination, and interpretation:
    a. amphetamines
    b. antiepileptics
        (1) dilantin
        (2) phenobarbital

c. barbituates

d. bromide

e. cardiac glycosides

(1) digoxin

(2) digitoxin

f. metals

(1) arsenic

(2) iron

(3) lead

(4) lithium

(5) mercury

g. hemoglobin derivatives

(1) carboxyhemoglobin

(2) cyanmethemoglobin

(3) methemoglobin

h. salicylates

Student Objectives:

The student will be able to:

1. Define the term toxicology.
2. State the general desired specimens for toxicological analysis.
3. State the effects of alcohol.
4. State the clinical significance of ethanol.
5. List the required specimen for ethanol analysis.
6. State the principle of one method for the determination of ethanol.
7. Interpret the blood ethanol result.

8. For the following drugs and substances, state clinical indications, correlations, metabolism, required specimen, one method of determination, and interpretation.
   a. amphetamines
   b. antiepileptics
      (1) dilantin
      (2) phenobarbital
   c. barbituates
   d. bromide
   e. cardiac glycosides
   f. metals
      (1) arsenic
      (2) iron
      (3) lead
      (4) lithium
      (5) mercury
   g. hemoglobin derivatives
      (1) carboxyhemoglobin
      (2) cyanomethenoglobin
      (3) methemoglobin
   h. salicylate

Instructional Techniques:

Lecture

The lecture is used to present and explain the metabolism, clinical indications and correlations, and methods of determination for toxic agents and potentially toxic substances.

Textbook

The textbook contains information on the various drugs, their metabolism, clinical indications and correlations, and methods of determinations. This information is used for further clarifications.

Chalkboard

The chalkboard is used to outline information concerning the various drugs.

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